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On the Rate of Mortality amongst Europeans and their Descendants residing in the Island of Jamaica.

By J. MARSHALL, *Esq., Actuary of the Jamaica Mutual Life Assurance Company.*

TABLE *showing the Mean Probabilities of Human Life, with the values of the Annuities and Reversions, &c., as deduced therefrom.*

AGE.	Average Expectation of Life.	YEARLY PROBABILITIES.		Number of Living at Birth, or who enter on each year.	LOGARITHMS.		Value of Life Annuity.		Single Premium for Assurance of £100 at death.	Annual Premium, whole term of Life.	Premium for One Year.	Single Premium for Assurance of £100 at death.	Annual Premium, whole term of Life.	Premium for One Year.	AGE.	The age the Life will attain, on the average expectation.	Also the fractional portion (further) of the ensuing year.
		Of Surviving each year.	Of the Life failing during the same; or Law of mortality yearly.		Logarithm strictly of the Surviving portion.	Of the Probability of Surviving each year.	3 per Ct.	4 per Ct.	3 per Cent.			4 per Cent.					
0	19·76	·742489	·257511	34205	4·534 0896	$\bar{1}$·870 6902	10·870	9·388	..	..	..	..	..	..	0	19	·76
1	25·43	·841965	·158035	25397	·404 7798	·925 2942	14·079	12·150	..	..	..	..	..	..	1	26	·43
2	29·12	·931072	·068928	21383	·330 0740	·968 9834	16·223	14·008	..	..	..	..	..	..	2	31	·12
3	30·23	·950597	·049403	19909	·299 0574	·977 9966	16·947	14·647	..	..	..	..	..	..	3	33	·23
4	30·78	·969438	·030562	18926	·277 0540	·986 5202	17·363	15·024	..	..	..	..	..	..	4	34	·78
5	30·73	·970555	·029445	18347	·263 5742	·987 0203	17·448	15·118	..	..	..	..	..	..	5	35	·73
6	30·65	·976916	·023084	17807	·250 5945	·989 8575	17·517	15·200	..	..	..	..	..	..	6	36	·65
7	30·36	·981435	·018565	17396	·240 4520	·991 8614	17·469	15·181	..	..	..	..	..	..	7	37	·36
8	29·93	·986243	·013757	17073	·232 3134	·993 9837	17·333	15·087	..	..	..	..	..	..	8	37	·93
9	29·34	·989538	·010462	16838	·226 2971	·995 4325	17·102	14·909	..	..	..	..	..	..	9	38	·34
10	28·64	·990837	·009163	16662	·221 7296	·996 0022	16·801	14·669	..	..	..	..	..	..	10	38	·64
11	27·90	·988982	·011018	16509	·217 7318	·995 1884	16·465	14·397	..	..	..	..	..	..	11	38	·90
12	27·21	·987127	·012873	16328	·212 9202	·994 3731	16·148	14·140	..	..	..	..	..	..	12	39	·21
13	26·56	·985272	·014728	16117	·207 2933	·993 5562	15·849	13·897	..	..	..	..	..	..	13	39	·56
14	25·95	·983416	·016584	15880	·200 8495	·992 7372	15·569	13·669	..	..	..	..	..	..	14	39	·95
15	25·37	·981560	·018440	15617	·193 5867	·991 9169	15·307	13·455	..	..	..	..	..	..	15	40	·37

AGE.	Average Expectation of Life.	YEARLY PROBABILITIES.		Number of Living at Birth, or who enter on each year.	LOGARITHMS.		Value of Life Annuity.		Single Premium for Assurance of £100 at death.	Annual Premium, whole term of Life.	Premium for One Year.	Single Premium for Assurance of £100 at death.	Annual Premium, whole term of Life.	Premium for One Year.	AGE.	The age the Life will attain, on the average expectation.	Also the fractional portion (further) of the ensuing year.
		Of Surviving each year.	Of the Life failing during the same; or Law of mortality yearly.		Logarithm strictly of the Surviving portion.	Of the Probability of Surviving each year.	3 per Ct.	4 per Ct.	3 per Cent.			4 per Cent.					
16	24·84	·980272	·019728	15329	4·185 5036	$\bar{1}$·991 3466	15·062	13·256	. .	. .	. .	. .	. .	. .	16	40	·84
17	24·33	·978196	·021804	15026	·176 8502	·990 4258	14·826	13·064	. .	. .	. .	. .	. .	. .	17	41	·33
18	23·86	·976056	·023944	14699	·167 2760	·989 4748	14·611	12·889	. .	. .	. .	. .	. .	. .	18	41	·86
19	23·44	·974226	·025774	14347	·156 7508	·988 6597	14·418	12·733	. .	. .	. .	. .	. .	. .	19	42	·44
20	23·04	·971940	·028060	13977	·145 4105	·987 6395	14·243	12·593	55·6029	3·648	2·724	47·7192	3·511	2·698	20	43	·04
21	22·69	·970356	·029644	13585	·133 0500	·986 9311	14·094	12·475	56·0369	3·713	2·878	48·1731	3·575	2·850	21	43	·69
22	22·37	·969910	·030090	13182	·119 9811	·986 7314	13·960	12·370	56·4272	3·772	2·921	48·5769	3·633	2·893	22	44	·37
23	22·05	·969450	·030550	12785	·106 7125	·986 5254	13·825	12·264	56·8204	3·833	2·966	48·9846	3·693	2·938	23	45	·05
24	21·73	·968976	·031024	12395	·093 2379	·986 3130	13·688	12·156	57·2194	3·896	3·012	49·4000	3·755	2·983	24	45	·73
25	21·41	·968488	·031512	12010	·079 5509	·986 0943	13·550	12·047	57·6214	3·960	3·059	49·8192	3·818	3·030	25	46	·41
26	21·09	·967982	·032018	11632	·065 6452	·985 8673	13·411	11·936	58·0262	4·027	3·109	50·2461	3·884	3·079	26	47	·09
27	20·77	·967462	·032538	11259	·051 5125	·985 6339	13·270	11·824	58·4369	4·095	3·159	50·6769	3·952	3·129	27	47	·77
28	20·45	·966924	·033076	10893	·037 1464	·985 3923	13·128	11·710	58·8505	4·166	3·211	51·1154	4·022	3·180	28	48	·45
29	20·13	·966368	·033632	10533	·022 5387	·985 1425	12·984	11·595	59·2699	4·238	3·265	51·5577	4·094	3·234	29	49	·13
30	19·82	·965792	·034208	10178	·007 6812	·984 8836	12·839	11·478	59·6922	4·313	3·321	52·0077	4·168	3·289	30	49	·82
31	19·50	·965198	·034802	9830	3·992 5648	·984 6164	12·693	11·360	60·1175	4·390	3·379	52·4615	4·244	3·346	31	50	·50
32	19·19	·964580	·035420	9488	·977 1812	·984 3383	12·545	11·240	60·5485	4·470	3·439	52·9231	4·324	3·406	32	51	·19
33	18·87	·963942	·036058	9152	·961 5195	·984 0509	12·396	11·119	60·9825	4·552	3·501	53·3884	4·405	3·467	33	51	·87
34	18·56	·963280	·036720	8822	·945 5704	·983 7525	12·246	10·996	61·4194	4·637	3·565	53·8615	4·490	3·531	34	52	·56
35	18·25	·962592	·037408	8498	·929 3229	·983 4422	12·094	10·872	61·8621	4·725	3·632	54·3384	4·577	3·597	35	53	·25
36	17·94	·961880	·038120	8180	·912 7651	·983 1209	11·941	10·746	62·3078	4·815	3·701	54·8231	4·667	3·665	36	53	·94
37	17·63	·961140	·038860	7868	·895 8860	·982 7867	11·787	10·619	62·7563	4·908	3·773	55·3115	4·760	3·737	37	54	·63
38	17·32	·960370	·039630	7563	·878 6727	·982 4386	11·632	10·490	63·2078	5·004	3·848	55·8077	4·857	3·811	38	55	·32
39	17·02	·959568	·040432	7263	·861 1113	·982 0757	11·475	10·360	63·6651	5·103	3·925	56·3077	4·957	3·888	39	56	·02
40	16·72	·958184	·041816	6969	·843 1870	·981 4489	11·317	10·229	64·1253	5·206	4·060	56·8115	5·059	4·021	40	56	·72

41	16·42	·956730	·043270	6678	3·824 6359	1̄·980 7894	11·165	10·102	64·5680	5·308	4·201	57·3000	5·161	4·161	41	57	·42
42	16·14	·955198	·044802	6389	·805 4253	·980 0934	11·020	9·981	64·9903	5·407	4·350	57·7654	5·260	4·308	42	58	·14
43	15·87	·954172	·045828	6103	·785 5187	·979 6267	10·883	9·867	65·3892	5·503	4·449	58·2038	5·356	4·407	43	58	·87
44	15·61	·953096	·046904	5823	·765 1454	·979 1367	10·748	9·755	65·7825	5·600	4·554	58·6346	5·452	4·510	44	59	·61
45	15·36	·951970	·048030	5550	·744 2821	·978 6233	10·615	9·645	66·1699	5·697	4·663	59·0577	5·548	4·618	45	60	·36
46	15·11	·950788	·049212	5283	·722 9054	·978 0837	10·485	9·537	66·5485	5·794	4·778	59·4731	5·644	4·732	46	61	·11
47	14·86	·949546	·050454	5023	·700 9891	·977 5161	10·358	9·432	66·9184	5·892	4·898	59·8769	5·740	4·851	47	61	·86
48	14·63	·948242	·051758	4770	·678 5052	·976 9192	10·236	9·330	67·2738	5·987	5·025	60·2692	5·834	4·977	48	62	·63
49	14·40	·946184	·053816	4523	·655 4244	1·975 9756	10·119	9·233	67·6146	6·081	5·225	60·6423	5·926	5·175	49	63	·40
50	14·19	·943298	·056702	4280	·631 4000	·974 6489	10·015	9·149	67·9175	6·166	5·505	60·9654	6·007	5·452	50	64	·19
51	14·01	·943250	·056750	4037	·606 0489	·974 6268	9·935	9·087	68·1505	6·232	5·510	61·2038	6·068	5·457	51	65	·01
52	13·82	·943200	·056800	3808	·580 6757	·974 6038	9·849	9·019	68·4010	6·305	5·515	61·4654	6·135	5·462	52	65	·82
53	13·62	·943150	·056850	3592	·555 2795	·974 5808	9·755	8·945	68·6748	6·385	5·519	61·7500	6·209	5·466	53	66	·62
54	13·42	·943100	·056900	3387	·529 8603	·974 5577	9·653	8·863	68·9718	6·474	5·524	62·0654	6·293	5·471	54	67	·42
55	13·20	·943000	·057000	3195	·504 4180	·974 5117	9·543	8·774	69·2922	6·572	5·534	62·4077	6·385	5·481	55	68	·20
56	12·96	·942900	·057100	3013	·478 9297	·974 4656	9·423	8·676	69·6418	6·682	5·544	62·7846	6·489	5·490	56	68	·96
57	12·72	·942800	·057200	2841	·453 3953	·974 4196	9·293	8·570	70·0204	6·803	5·553	63·1923	6·603	5·500	57	69	·72
58	12·46	·942700	·057300	2678	·427 8149	·974 3735	9·152	8·454	70·4311	6·938	5·563	63·6384	6·731	5·510	58	70	·46
59	12·19	·942600	·057400	2525	·402 1884	·974 3274	8·999	8·327	70·8767	7·088	5·573	64·1269	6·875	5·519	59	71	·19
60	11·90	·942000	·058000	2380	·376 5158	·974 0509	8·833	8·187	71·3602	7·257	5·631	64·6654	7·039	5·577	60	71	·90
61	11·60	·941000	·059000	2242	·350 5667	·973 5896	8·658	8·039	71·8699	7·442	5·728	65·2346	7·217	5·673	61	72	·60
62	11·30	·940000	·060000	2109	·324 1563	·973 1279	8·477	7·885	72·3971	7·639	5·825	65·8269	7·409	5·769	62	73	·30
63	10·98	·939000	·061000	1983	·297 2842	·972 6656	8·289	7·724	72·9447	7·853	5·922	66·4461	7·616	5·865	63	73	·98
64	10·67	·938000	·062000	1862	·269 9498	·972 2028	8·092	7·555	73·5184	8·086	6·019	67·0961	7·843	5·962	64	74	·67
65	10·34	·937000	·063000	1746	·242 1526	·971 7396	7·886	7·376	74·1185	8·341	6·117	67·7846	8·093	6·058	65	75	·34
66	10·00	·936000	·064000	1636	·213 8922	·971 2758	7·669	7·187	74·7505	8·623	6·214	68·5115	8·368	6·154	66	76	·00
67	9·65	·935000	·065000	1532	·185 1680	·970 8116	7·439	6·985	75·4204	8·937	6·311	69·2885	8·677	6·250	67	76	·65
68	9·29	·934000	·066000	1432	·155 9796	·970 3469	7·195	6·769	76·1311	9·290	6·408	70·1192	9·026	6·346	68	77	·29
69	8·90	·932000	·068000	1338	·126 3265	·969 4159	6·934	6·537	76·8913	9·691	6·602	71·0115	9·422	6·538	69	77	·90
70	8·52	·930000	·070000	1247	·095 7424	·968 4829	6·663	6·294	77·6806	10·137	6·796	71·9461	9·864	6·731	70	78	·52
71	8·13	·927000	·073000	1159	·064 2253	·967 0797	6·379	6·039	78·5078	10·639	7·087	72·9269	10·360	7·019	71	79	·13
72	7·72	·923000	·077000	1075	·031 3050	·965 2017	6·088	5·775	79·3553	11·196	7·476	73·9423	10·914	7·404	72	79	·72
73	7·33	·919355	·080645	992	2·996 5067	·963 4833	5·794	5·507	80·2117	11·806	7·830	74·9731	11·522	7·754	73	80	·33
74	6·92	·912281	·087719	912	·959 9900	·960 1287	5·491	5·230	..	..	..	..	..	..	74	80	·92
75	6·54	·903846	·096154	832	·920 1187	·956 0945	5·199	4·962	..	..	..	..	..	..	75	81	·54

AGE.	Average Expectation of Life.	YEARLY PROBABILITIES.		Number of Living at Birth, or who enter on each year.	LOGARITHMS.		Value of Life Annuity.		3 per Cent.			4 per Cent.			AGE.	The age the Life will attain, on the average expectation.	Also the fractional portion (further) of the ensuing year.
		Of Surviving each year.	Of the Life failing during the same; or Law of mortality yearly.		Logarithm strictly of the Surviving portion.	Of the Probability of Surviving each year.	3 per Ct.	4 per Ct.	Single Premium for Assurance of £100 at death.	Annual Premium, whole term of Life.	Premium for One Year.	Single Premium for Assurance of £100 at death.	Annual Premium, whole term of Life.	Premium for One Year.			
76	6·18	·897607	·102393	752	2·876 2132	·953 0862	4·925	4·710	..	..	..	..	..	..	76	82	·18
77	5·83	·891852	·108148	675	·829 2994	·950 2928	4·652	4·457	..	..	..	..	..	..	77	82	·83
78	5·48	·887043	·112957	602	·779 5922	·947 9447	4·372	4·197	..	..	..	..	..	..	78	83	·48
79	5·11	·878277	·121723	534	·727 5369	·943 6314	4·077	3·921	..	..	..	..	..	..	79	84	·11
80	4·75	·865672	·134328	469	·671 1683	·937 3534	3·781	3·643	..	..	..	..	..	..	80	84	·75
81	4·41	·852217	·147783	406	·608 5217	·930 5502	3·499	3·337	..	..	..	..	..	..	81	85	·41
82	4·09	·835260	·164740	346	·539 0719	·921 8217	3·229	3·122	..	..	..	..	..	..	82	86	·09
83	3·80	·809689	·190311	289	·460 8936	·908 3183	2·982	2·887	..	..	..	..	..	..	83	86	·80
84	3·58	·794872	·205128	234	·369 2119	·900 2972	2·793	2·708	..	..	..	..	..	..	84	87	·58
85	3·37	·779570	·220430	186	·269 5091	·891 8551	2·620	2·543	..	..	..	..	..	..	85	88	·37
86	3·19	·765517	·234483	145	·161 3642	·883 9549	2·462	2·393	..	..	..	..	..	..	86	89	·19
87	3·01	·747748	·252252	111	·045 3191	·873 7552	2·312	2·251	..	..	..	..	..	..	87	90	·01
88	2·86	·746988	·253012	83	1·919 0743	·873 3136	2·185	2·131	..	..	..	..	..	..	88	90	·86
89	2·66	·741935	·258065	62	·792 3879	·870 3659	2·013	1·967	..	..	..	..	..	..	89	91	·66
90	2·41	·739131	·260869	46	·662 7538	·868 7214	1·794	1·758	..	..	..	..	..	..	90	92	·41
91	2·09	·705882	·294118	34	·531 4752	·848 7321	1·501	1·474	..	..	..	..	..	..	91	93	·09
92	1·75	·666667	·333333	24	·380 2073	·823 9090	1·190	1·171	..	..	..	..	..	..	92	93	·75
93	1·37	·562500	·437500	16	·204 1163	·750 1225	0·839	0·827	..	..	..	..	..	..	93	94	·37
94	1·05	·444444	·555556	9	0·954 2388	·647 8170	0·536	0·530	..	..	..	..	..	..	94	95	·05
95	0·75	·250000	·750000	4	·602 0558	·397 9400	0·242	0·240	..	..	..	..	..	..	95	95	·75
96	0·50	..	..	1	1·999 9958	..	0·000	0·000	..	..	..	..	..	..	96	96	·50

From Birth to 96, both inclusive; Sum of the Series. . 692,860.

„ „ Total decrements. . 34,205; and 692,860 ÷ 34,205 — ·5 = 19·76 Expectation of Life at Birth.

OBSERVATIONS ON THE PRECEDING TABLE.

As already stated by the writer, in a former paper on the subject, " In the absence of any large collection of facts and observations in Jamaica, from which such a table could have been deduced, he has necessarily been compelled to proceed upon probability and approximation, according to the experience and opinions of persons whose age and long residence in the community, or whose peculiar means of information, would give weight and authority to their statements; and, as a consequence, to any system which might be based upon them.

" Looking at the value of life in Jamaica, as respects the mass of the male population (subject of course to great variation on account of climate, habits of life, &c.), over the last thirty-four years, it has been the generally received opinion that the ratio of mortality, upon an average of years, was 5 per cent. annually—all classes, of course, select or otherwise, included in the category, but presenting very great variations in detail; and the same appears to have been the conviction of the Government Actuary, Mr. Finlaison, who distinctly states (*Report on the Clergy Fund,* Votes Ass. xliv. app. 405),—' Among those inured to the climate, the rate of mortality in Jamaica, at the age of 66 and upwards, is the same as it is in England; at all younger ages it cannot be safely taken at less than 5 per cent., without variation.' "

Accordingly, in the table in question, the mean expectation of life, as well at birth as at the age of 30, will be found to involve a mean mortality, *communibus annis,* of 5 per cent.; and while the mean expectation of life in Jamaica, at the age of 66, appears as 10 years, against 10·42 in the Northampton Table, the yearly rate of mortality *after* the age of 72 will be seen to be the same in both cases.

Between birth and the age of 10 inclusive, owing to the mildness of epidemical disease among children in a tropical climate, the mortality cannot be deemed higher in Jamaica than in the mother country, according to the Northampton observations; and the probabilities therefore appear, over such period, as equal also.

With regard to the interval between 14 and 51, the decrements at every age are treated as double those arising on the Northampton observations; while between 10 and 15, and between 50 and 73, the difference between the two extremes in each case is distributed over the intermediate ages by such interpolations as local opinion and experience seemed to warrant; the retarded ratio in the increase of mortality in Jamaica, between 50 and 72 (in the earlier decade more especially), as distinguished from the experience in England, being reflected by the local table.

The probabilities being thus preliminarily determined, the terms of the series of the living, from the limiting age down to that of 73 in the Northampton Table, remain unaltered; the number of the living, 992 at the last mentioned age, forming *in the first instance* the first term of an *increasing* series, in which, proceeding by the *converse* operation, the *increasing* number at every younger age is made to develope itself successively until birth; when the number of the living, 34,205, thus generated, constitutes the base or radix of the Jamaica Table. Proceeding subsequently on that number as the first term of a *decreasing* series, the truth of the operation in the first instance is confirmed, and the eventual results are those arising on the construction according to the ordinary method; with this peculiarity, however, that the original probabilities are rigidly maintained in the second process by the insertion of the logarithms of the true surviving portion at every age, and not of the nearest *integral* numbers as they respectively appear in the different terms of the series; to meet which (and not the true surviving quantity) had the corresponding logarithms been inserted, the then probabilities, though an approximation and a very near one, would nevertheless have ceased to be the *same;* while, on the other hand, to have maintained a perfect equality between the two, the very inconvenient introduction of fractions into the column of the living would have been unavoidable. The true measure of probability in *one* of the two cases, at least, has thus been retained.

It is observed, in the valuable *Essay on Probabilities,* by Sir William Lubbock and J. E. D. Bethune, Esq., in allusion to Dr. Price's alteration of the original radix of his table to 11,650—"Why he chose this number in preference to any other we have not been able to discover;" but Dr. Price distinctly states that "he increased the radix from 1,165, in his first table, to 11,650, in order to adjust the decrements with greater regularity and precision, " thus leaving the number 1,165, which he first adopted, as the only point for speculative inquiry. Now his probabilities at every age must have been preliminarily determined by him on his 4,689 actual observations and their interpolations: and having been so, it must be obvious that, having assumed the limiting age and its adjacent numbers, the radix of his table in the outset would necessarily be an *unknown* quantity, obtainable only by proceeding from the apex or some adjacent point to the base, and not, according to the ordinary method of constructing such a table, by the contrary process; and assuming the fact to be so, the number 1,165 will be found to be the quantity necessarily presenting itself at birth, and as forming, consequently, the radix of his table as first adopted by him, though subsequently increased in a tenfold ratio. Nor can it appear very doubtful, after all that has gone before, that in constructing a table of probabilities otherwise than from the facts themselves, and where a limiting age is assumed, that the correct process must be by proceeding in the *first* instance from the apex to the base, rather than by the alternative method more usually adopted; and that, in any such table, if the *true* measure of probability is to be preserved, and whole numbers only are to be admitted into the series of the living, *that true measure* can be presented only by the true logarithms as above stated. In this manner has the number 34,205 been obtained as the radix of the Jamaica Table, being the quantity found to be proportionate at the base to the number 11,650, which forms the base or radix of the Northampton; the higher mortality of the first being taken into account. The precise terms of the series in the Northampton Table, after the age of 72, are thus preserved as common to each; the probabilities after such age, as a consequence, together with the values deducible therefrom, being precisely equal also.

In reference to the adoption of a table of probabilities on *hypothesis* (if so to be termed), as based *upon general experience and observation of the variation at the different* periods of life *of the mortality among Europeans and descendants of Europeans residing in Jamaica, from an established European standard* rather than upon a *specific body of observations*—it may be affirmed, to say nothing of the impracticability of obtaining a body of specific data in Jamaica as affording a probable criterion of the general mortality, that there is danger also in relying implicitly on *any* body of observations as an index to future events. A law of mortality, *for instance,* has recently been deduced by a committee of English actuaries, associated for the purpose, from the combined experience of seventeen of the London Life Assurance Offices, embracing the very large body of observations involved in 62,537 policies of assurance; and the results so obtained might fairly have been considered, agreeably with the confident expectations entertained, as calculated to establish conclusively the true probabilities of human life as applied to assurances and annuities on lives in the United Kingdom. But what is the aspect of the case, analytically considered, now that these results are before the public? I quote the words of the committee from whose combined labours they have proceeded, giving the more remarkable passages in italics:—

"In reference to the materials from which the whole of the tables have been formed, they represent a lower rate of mortality than can be expected to prevail in a *longer period of time* than that over which the present observations extend, for the duration of policies embraced *in nearly one half of the experience is under* 5½ *years;* and taking the whole of the experience together, which includes that of the Equitable and Amicable, the two oldest Offices existing, *the average duration of all the policies is not* 8½ *years.* This is readily accounted for when it is seen that more than half the policies effected were existing at the termination of the observations, and nearly a third had been discontinued during the lifetime of the parties assured. *The circumstance of recent selection should not be lost sight of by such persons as may use these tables either for the sake of comparison or as the basis of other tables for granting assurances. The difference in the rate of mortality between recently selected lives and those of longer continuance in the Society is clearly shown by Mr. Galloway in the tables of mortality deduced by him from the experience of the 'Amicable' Society,* and which that Society, like the Equitable, has recently so disinterestedly printed for the use of its members." (*See* the work of Jenkin Jones, introduction, page 16, and elsewhere.) In fact, no scheme that ever was or ever will be propounded for the regulation of the future by the experience of the past, can possibly be divested of the character of "*hypothesis*"; much less can any such hypothesis acquire due importance or authority, until a long and well authenticated train of subsequent events, extending over a period equal at the least to the scriptural *complement* of human life, shall have tested the soundness of its predictions.

So circumstanced, all that can be aimed at is, to approach the truth, *in the first instance,* as nearly as our very limited knowledge of the future will permit; and, assuming an unquestionable margin of safety in the outset, to provide for such a measure of compensation in the sequel as time and the actual experience of the Society may dictate; remembering always as peculiarly applying to *any* theory of probabilities on which a Society may choose to base its computations, that

> "Est *modus* in rebus; sunt certi, denique, fines,
> Quos ultra citra que nequit consistere rectum."

With reference now to the determination and distribution of surplus, and the preliminary arrangements of a Mutual Life Assurance Society:—Let a rate of interest somewhat below that which can probably be depended on be adopted as the governing rate in all computations, and let the table of probabilities be such as to embrace a marginal protection to the Office; proportionate, also, as nearly as can be ascertained, at *all* ages. Let the equated annual premium, as mathematically deduced from it, be P'; let the assurances amount —say, R—to £100,000, and the yearly office expenses, E, to £500; $\frac{E}{R}$ then will require ·5 as the addition to the premium for every £100 assured, the yearly contributions for expenses being irrespective of the age; and P', at the different ages, *plus* ·5, will compose the yearly prepayment, or premium P; the net present value of the reversion of £1, or the single premium, computed from a similar table, being denoted by V, a quantity varying with the age. Let the several quantities P, subject to an exceptional feature to be presently noticed, be deemed fully equal to the calls and expenses of the Office, and something more, and let the same be deemed, as between contributors to a common fund, relatively equal also; the extra payment in each case *beyond that attaching to the standard* or best age in the table being severally taken as compensatory merely, for an extra risk, D; and let the payment at such "standard" age be denoted by a, and the annuity of £1 by A.

But the law of average forms the basis of all such computations; and as no such law can be relied on in individual cases, nor can be expected to obtain otherwise than as regards the mass, it will be obvious that such a criterion becomes inapplicable whether derived from or as applied to a few observations or *particular* cases. Now in any particular community, let the experience, and also the number of cases to which we may be called on to apply the *first,* be so limited as to be confessedly obnoxious to that objection above the age of 50. Such risks can only be prudently accepted with a marginal addition *quasi* proportionate to their paucity; and therefore let such a quantity, varying between 50 and upwards, be denoted by Q; then will it follow, that the expenses of the Office being rated on the £100 assured without reference to age, *and being therefore* proportionately furnished at the hands of all, in the case of a uniform assurance of £100; and the extra payments D, beyond that attaching to the "standard" age, being at the several increased ages merely compensatory; the *yearly* quantity a, thus paid in common by every member of the Society, will be the cardinal and exclusive feature for consideration, in arriving at a rule for the appropriation of a surplus; the annual prepayment a, and its accumulations (rated, after the first, always from the *last* investigation) *over any number of years, n* (equal to $a(1+A^{n-1})$, being, *primâ facie,* the exponent of the rights of each member thereon; but a being a constant multiplier, in such a series the ratio of the terms will remain unaltered by its elimination; the *simple* equivalent exponent at every term of the series consequently becoming $(1+A^{n-1})$; and the dividend surplus S (after deduction of the "rest" or guarantee fund) having been determined,* $\frac{S}{f.\,(1+A^{n-1})} \times (1+A^{n-1})$, (where f denotes merely the summation), will exhibit the cash payment, *s*, in the case of a uniform assurance of £100, to which each member will be entitled who may have contributed one (or more) full year's premium; any who may have contributed *less* being, in respect to such fractional portion, excluded from participation.

But the preceding theorem supposes a uniform assurance of £100; and, the assurances *varying in amount,* let every hundred or number of hundreds so assured on the same life be treated as 1, 2, 3, 4, &c., and be denoted by h; then will the terms of the ratio become $h \times (1+A^{n-1})$, and $\frac{S}{f.\,[h(1+A^{n-1})]} \times h(1+A^{n-1})$ will give the ultimate appropriation s, proportionate in each case to the amount assured and to the duration of the policy, *computing, after the first, always from the last investigation.*

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* In determining the surplus, and the value of each policy, it will be proper to throw off, whether after the age of 50 or in the case of lives taxed as below the average, any extra quantity beyond P (or mathematical premium, *plus* E).

With the preceding exception, under arrangements such as the above, it will be found most convenient and also most correct to take the entire value of the future premiums, without deduction, in the first instance; deducting at the conclusion of the process, from their aggregate value, that of three months' expenses *plus* the product of a life annuity of £1, payable *quarterly, multiplied by the amount of the actual annual expenses;* the value of the annuity being taken as of the mean age at investigation; *no anticipation of future profits* then occurring.

In throwing off E or any other quantity, and multiplying the difference in each case by the annuity *plus* 1, the effect is clearly to take one entire year's expenses, &c., *in hand;* which is excessive.

The value of V will be most correctly arrived at by stating the ages, not as of the policy standard, but accordingly as the birthday may be nearer to the opening or termination of the Office year (which also would be the preferable mode of rating the premiums of entrants, and of stating the mortality results in a Society); and at whatever periods of the year the future premiums may be payable, *all* premiums should be taken at their *yearly* value, and *all* should be treated as due on the first day of the official year, their product being reckoned accordingly; the Society debiting itself with any past payments and the interest upon them, in respect to which risks may be *still* subsisting. Finally, in lieu of taking credit substantially for "*assets*" to the extent of the present value of the future premiums, by raising a *second* account for *liabilities* (in which the same are included), it were more correct, and more intelligible also, to raise one account only, showing the difference as constituting the "liability"—*i. e.*, the value of the aggregate reversion *minus* that of the rent charge attaching to it; each being inseparable from the other—each, nevertheless, being exhibited at every investigation, with the features expressly given by which the value of such rent charge may be diminished; nor after the lapse of the first seven years of a Society's existence, does there appear any rational ground for longer intervals between the investigations than three years, if due regard is to be had to the true interests of the members of such an Association.

Now, as the general rule of an Office—as distinguishable from the *exception* to be presently adverted to—let it be supposed that a reversionary bonus B is to be added to the previous assurance, equivalent to that which, as a single premium, s would purchase; then $\frac{s}{V}$ will give the true reversionary quantity B. Moreover, let there be also an *alternative*, at the option of the different numbers —viz., the power to claim, in lieu of B, the equivalent reduction of the annual premium; the Society, be it supposed, professing to grant annuities on the probabilities of the corrected Chester Table, involving higher probabilities of life than those of the table from which its premiums were computed.

Here, then, the reduction of the yearly premium being equivalent to granting on the same life a counter annuity by way of set off; in the case of an election, to be exercised with or without the concurrence of the Office, were the latter to base the reduction of the premium on the value of the annuity from which its premiums were originally computed, it would first expose the Society to the effects of *selection* highly injurious as against itself, and would further commit the anomaly of granting an annuity at *one* rate, while, for the same annuity, *and perhaps upon the same life, it was professedly* demanding a widely *different* consideration.

Where, therefore, such an alternative is to be left to the independent option of the member (who will naturally, if a bad life, accept the bonus—if a good one, demand the reduction in the premium)—if the Office is to preserve a due measure of protection, and of consistency also, the reduction in the value of the annual premium will be made equal to $\frac{s}{1+A}$ where the divisor represents the value of the life annuity of £1 by the *Chester* Table, the first payment in hand; its value being rated, *as in the case of* B, as of the *age* at the time of computation.

It is mainly to the anomalies admitted in the construction of the premiums of an Assurance Office *in the outset*, that the difficulty in the sequel of determining and correctly distributing a surplus is attributable; nor, among them, is any more prominent or more objectionable in principle, than the very frequent practice of providing for the annual expenses of an Office (apart from calls) by an addition to the annual premium at every age, rated, not upon the

£100 assured, but upon the consideration or premium annually paid for it at the different ages; such a procedure furnishing the only defence, *on the other* hand, for the erroneous and inequitable system of apportioning a surplus regardless altogether of the considerations attaching to incidental profits and to different decrements, in the ratio of the *accumulated premiums;* for beyond the obvious inequity as regards the *first* objection, as respects the *last,* the higher or lower premiums at the different ages, apart from the feature for expenses, being only proportioned to the different risks, and being therefore so far proportionate to one another, must be so far, also, *equally creative of a surplus.* Where, then, the *expenses* have been rated on the *premiums,* the accumulation of $a+E$ *only* should be the rule or measure of distribution.

Nor is the practice of various Offices less inequitable, which, in lieu of adding to a policy a reversionary bonus rated according to the age at the time of computation, makes the reversionary addition the same *at all ages in regard to the* £100 *assured,* and indifferently whether the assured be aged 30 or 90—an enormous injustice to the younger contributors, and to those more especially who, entering a Society between 20 and 30, and usually with more limited means than those of older entrants, are required, on the guarantee of compensatory *prospective* advantages, to contribute so largely and so long in excess of the consideration which an assurance from year to year, during a corresponding period, would legitimately require;* and (as all experience has shown) with the lower probability, too, of the maintenance of a policy over the younger ages as compared with that over a more advanced period of life, when, comparatively, few or no abandonments occur—an important feature in the practical working of assurances, and one which must have contributed largely to the almost incredible proportions to which the funds of some of the older Offices have attained; and if a new feature in the doctrine of probabilities, now propounded perhaps for the first time, one at least, unfortunately for the extension of a benevolent provision at the *younger* ages, never sufficiently adverted to.

The last and not the least anomaly it may be necessary to notice here, is that resulting from the doctrine that members whose lives have been under assurance for the *longest* period are to have preferable advantages over the subsequent entrants.

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* *See* the comparative rates of the London Equitable Society between the ages of 20 and 42, and between 30 and 50; as applied to an equated annual premium over the whole term of life, and to the equivalent premium *rated yearly, for a single year's assurance, toties quoties.* In the London Amicable and other Societies, the corresponding excess here referred to will be found to extend over a longer period even than the interval involved in the case of the Equitable.

Now, if from such a doctrine any *future* advantage is to be inferred beyond that attaching to the duration of the policy since the last period of investigation (as above provided for), *then,* looking at the benefit of *selection* in the *outset* of an assurance, and at the *converse* of the proposition *also,* such a position will be found to be untenable; inasmuch as the *subsequent* entrants must be considered to bring with them every compensatory *quid pro quo*—first in the increased influence which ensues, and secondly in that recruiting of the vitality of the body corporate which results from their admission, and which, as it were, by the infusion of younger blood into older veins, is so contributory, if not absolutely indispensable, to its well being and support; for of an Assurance Association or Society it may emphatically be stated, "*Vires acquirit eundo,*" while, on the other hand, the *ratio* of its annual expenditure decreases with the increase in the numbers who compose it.

NOTE.—We have omitted some of Mr. Marshall's tables and formulæ, as not being of any practical use here, and have also substituted notation used in this country for that given by him, which would not be readily understood. It is to be regretted that his data are not of a more authentic character. They are nevertheless not without value, as coming from one whom a residence on the spot must render familiar with whatever bears upon the facts.—ED. *A. M.*

DUTY ON FIRE INSURANCE.—One of the most remarkable mischiefs of modern times is, that taxes, which demoralize the people, and are avowed by all parties to be iniquitous and hurtful, should be still tenaciously retained. Such a tax is the one in question, seeing that it is a tax on one of the chief necessaries of civilized life. The working man must either leave his tools, his clothes, and his furniture—the plank, as it were, which stands between him and pauperism—uninsured, or he must pay three or four times as much as is required for the mere assurance. If the bread tax was odious, surely the fire insurance tax is indefensible. The striving tradesman cannot insure his stock-in-trade—partly the result of hard earnings, partly the property of his creditors—without paying thrice the amount that the Office requires. Thus, when the fatal fire comes, the industrious citizen is debased into the pauper, and the losses of his creditors contribute to other bankruptcies. Such systems are systems of national suicide rather than systems of just assessment of national burdens.—*Patriot.*